Composting air emissions:

New Research & Regulations

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This Presentation

1. CalReycle compost emissions reactivity studies
2. CalRecycle compost GHG study
3. San Joaquin and South Coast air district rule updates
4. New Source Review

2009-2010 Compost Emissions Reactivity Studies

- Focused on ozone formation potential (OFP), not VOC emissions factors
- Highly reactive VOCs have high OFP
- Identify all C compounds in the emissions
- Tested OFP of windrows, tip piles, overs
- Tested impact of a pseudo-biofilter overs cap on OFP

The Mobile Ozone Chamber Assay

a.k.a. MOChA chamber


Inside the MOChA chamber

First phase of the project

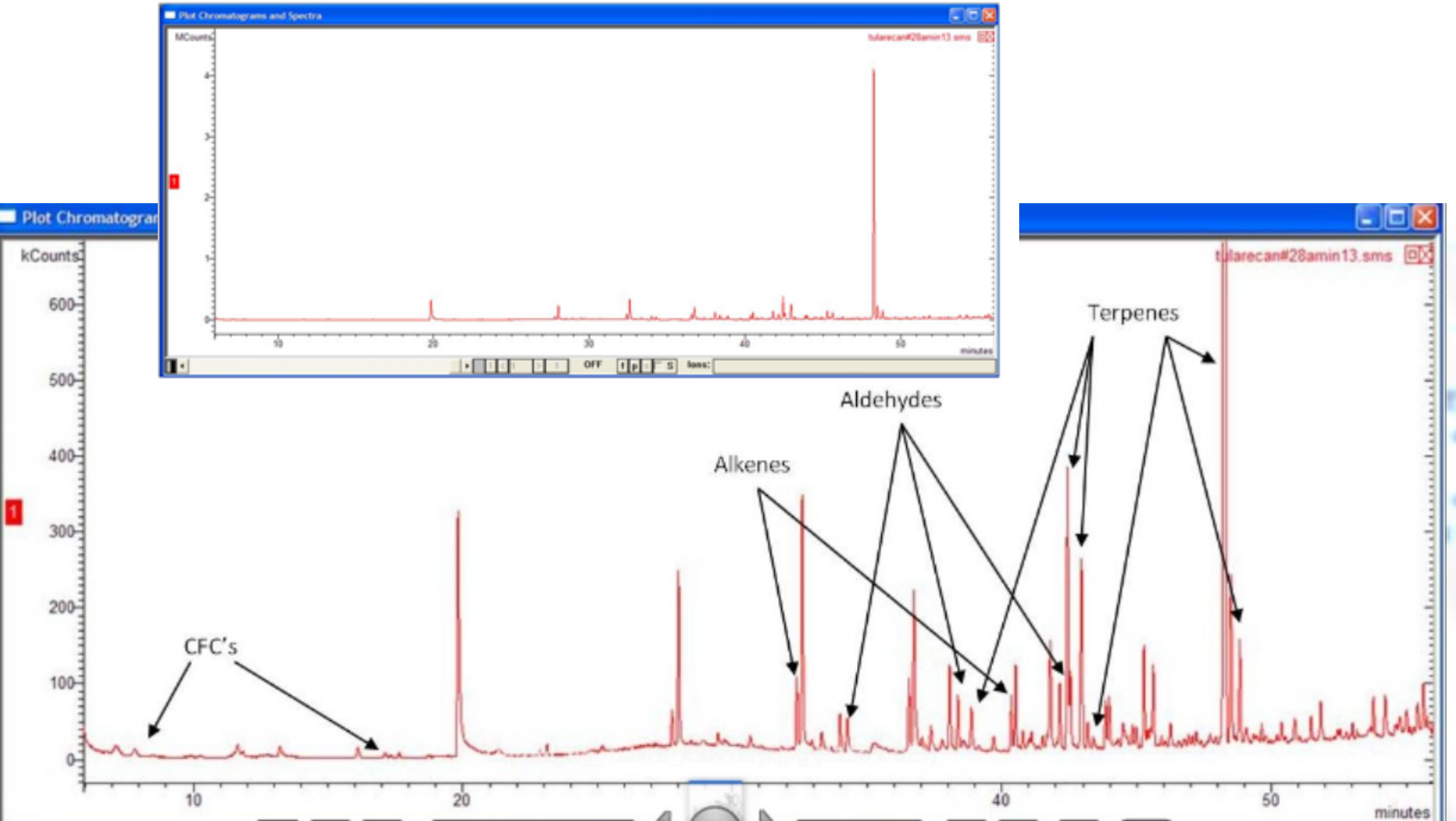
Fall-Winter, 2009

- Funded by StopWaste of Alameda County, Tulare County Compost & Biomass, Grover Landscaping Inc., All Valley Environmental, Tracy Material Recovery, City of Modesto
- Studied tipping piles, 5-day old windrows, 21-day old windrows
- Learning curve: dealing with high moisture
- Article in press, peer-reviewed journal, *Atmospheric Environment,* this winter

Bottom Line from Phase 1

- Compost emissions 80-95% ethanol, wood alcohol, isopropyl alcohol
- Light alcohols have low OFP
- More than 80 other compounds
- 1-3% highly reactive terpenes, aldehydes
- Windrow and tipping pile OFP low
- 3-week-old windrow slightly higher OFP than 5-day-old windrow

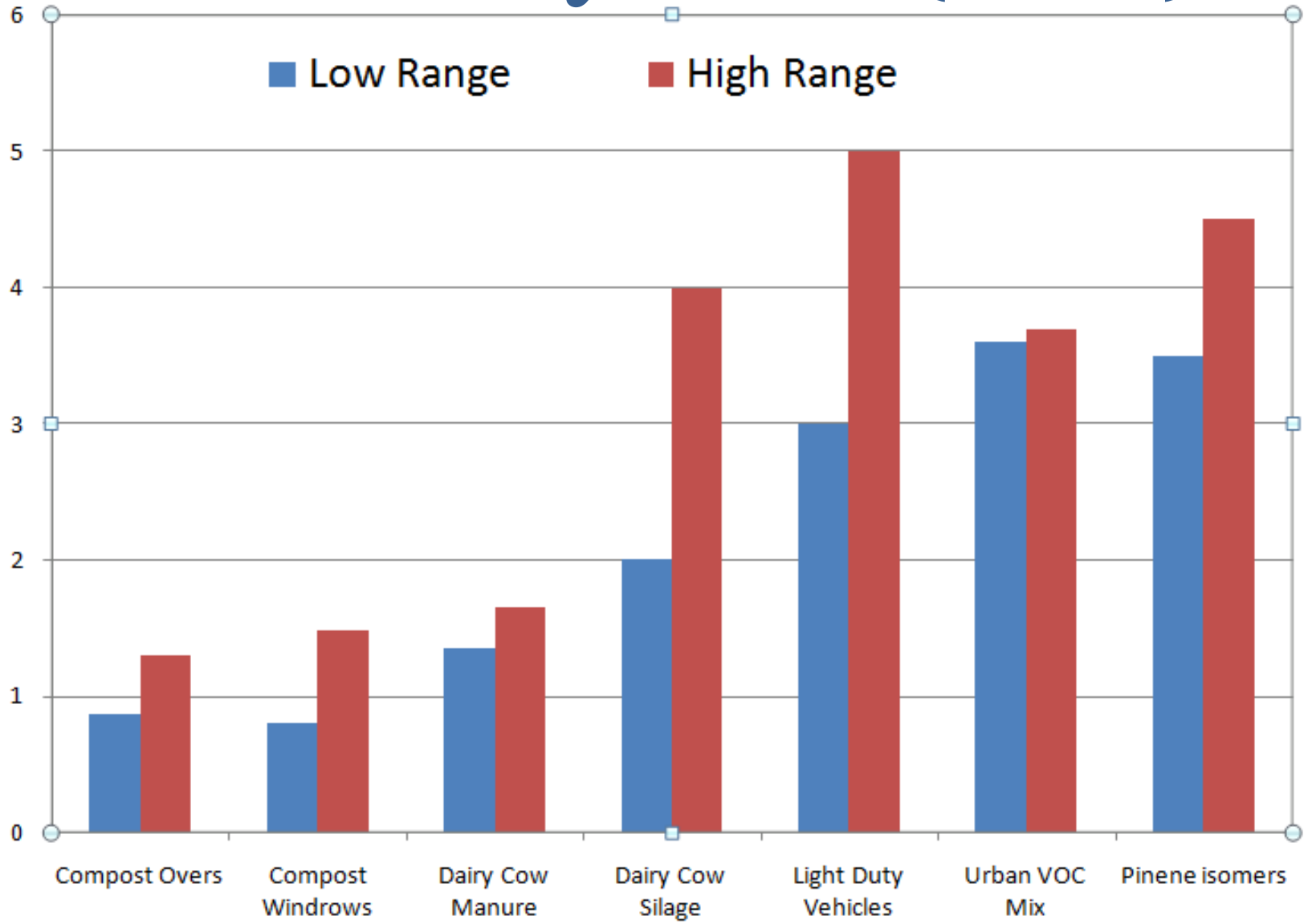
Spectrometer reading from compost emissions



To comply with accessibility requirements, this slide has been added to the original presentation to describe the graphic on the previous slide.

- The previous slide depicts the output from a spectrometer, showing the peaks which come from measuring compost emissions. Spectrometers measure the wavelengths of gas samples to determine the constituent gases within the mixture. Arrows point out the peaks associated with terpenes, aldehydes, and alkenes, three common groupings of volatile organic compounds.

Maximum Incremental Reactivity scale (MIR)



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- The previous slide depicts a bar graph comparing the ozone formation potential of various emissions sources, including compost windrows, piles of oversized previously composter materials, dairy cow manure and silage, typical urban VOC mixtures, exhaust from light duty gasoline powered vehicles and pinene, a common naturally occurring volatile organic compound. The ozone forming potential is expressed as a maximum incremental reactivity. Pinene has the highest reactivity. Composting related reactivity is roughly one third as potent as typical urban volatile organic compounds.

Second phase of the project
Spring-Summer, 2010

- Funded by CalRecycle
- Studied 6-week old windrows, overs piles
- Compared emissions from matched pairs of composting windrows:
  - 5 days old and 21 days old
  - Pseudo biofilter overs cap or not
- Report to be published by CalRecycle

Bottom Line from Phase 2

- Overs piles make almost no ozone
- OFP of 6 week-old piles very low
- Alcohols more than 90% of emissions
- Overs cap >25% effective in reducing OFP
- 3-week-old windrows still have higher OFP than younger windrows
- Maximum Incremental Reactivity of composting emissions mix .9 - 1.5: LOW

Compost cap was effective

- Average of two replicates
- Overall emissions reduced
- Reactivity of the capped mix not reduced

	Average O_3 reduction in ppbv	Average O_3 reduction in %	Method
5-Day Windrow	4.2	26.8%	MOChA only
5-Day Windrow	16.3	57.3%	MOChA and model
21-Day Windrow	16.4	36.1%	MOChA only
21-Day Windrow	23.0	50.4%	MOChA and model

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Compost GHG study

- Funded by CalRecycle, contractor is UC Davis
- Focus on N_20 and CH_4
- Draft study plan finalized in November
- Field work 2010-2012
- Final report June 2012

Two-pronged approach

1. Measure CH_4 and N_20 from composting windrows

2. Measure N_20 and CH_4 emissions from compost amended and conventionally fertilized croplands

GHGs from composting facilities

- Existing data comes from Europe and mostly concerns mixed waste
- Multiple methods to be used
  - Flux chambers
  - Access tubes into the pile
  - Micro-meteorological approach
- Year-round sampling
- Existing EPA/ARB estimates could be low

Compost impacts on cropland GHGs

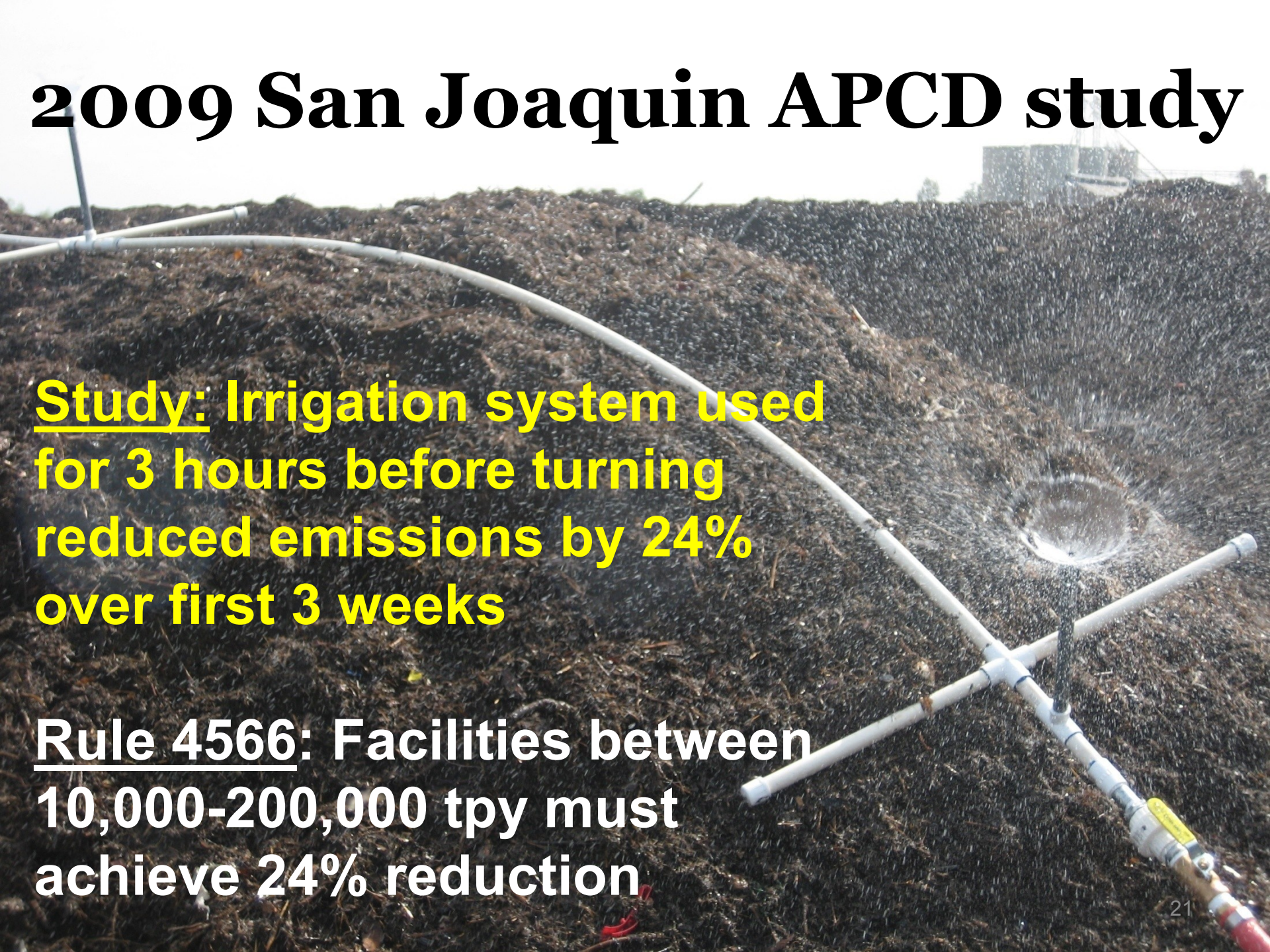
- Micro plots at UC Davis Russell Ranch site
- Field testing in tomato and nut farms
- Variable rates of compost
- Compost alone and also mixed with variable rates of N fertilizers
- Will measure yields
- Focused sampling after fertilization and irrigation / first rains

San Joaquin Rule 4566

Sept. 22, 2010 draft

- Feedstock holding times: 3 days all materials or cover with 6” compost cap
- Keep stockpiles below 122° F (50° C)
- Small facilities (<10,000 tpy): BMPs
  - Maintain O2 at 5% or above
  - Maintain H2O at 40-70%
- Keep stockpile and throughput records
- File plan with district on how to meet rule
- Go to air district board in April or May, 2011

2009 San Joaquin APCD study



Study: Irrigation system used for 3 hours before turning reduced emissions by 24% over first 3 weeks

Rule 4566: Facilities between 10,000-200,000 tpy must achieve 24% reduction

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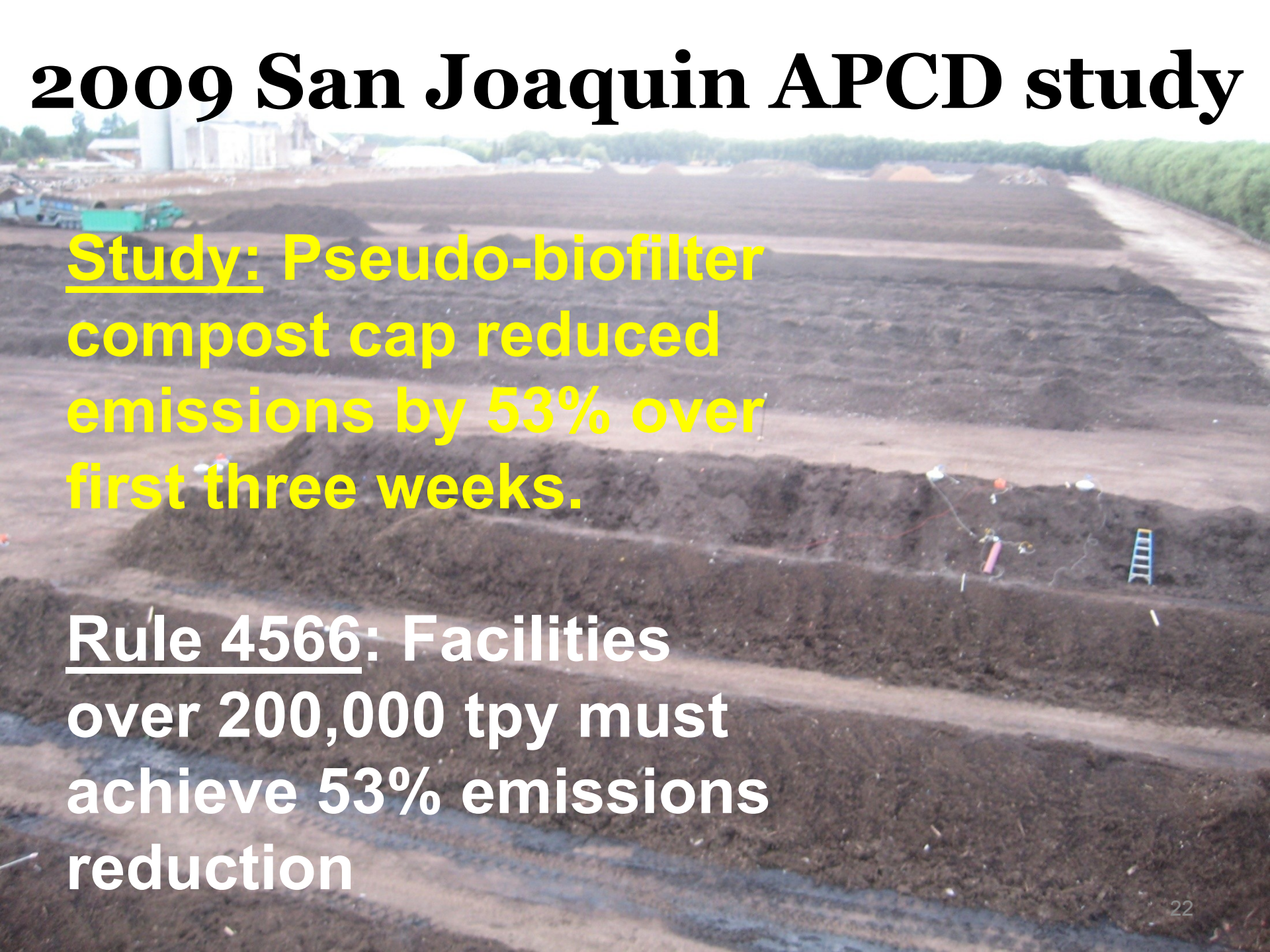

Study: Pseudo-biofilter compost cap reduced emissions by 53% over first three weeks.

Rule 4566: Facilities over 200,000 tpy must achieve 53% emissions reduction

Rule 1133 (South Coast AQMD)
Greater Los Angeles area)

- 1133.1 to be amended: feedstock holding times AFTER chipping/grinding, 3 days
- Same feedstock requirements for composters
- 3 days after grinding, use feedstocks as ADC, remove from site, or compost
- No passive static piles
- Looking for feedback on optimum temp, H_2O, O_2
- Facilities >10% foodwaste by weight need aeration system vented to biofilter
- Go to air district board in May, 2011

New Source Review in the SJV

- Not a future theoretical; here, now
- Any new facility with VOC emissions greater than 10 tons per year
- Any expanded facility with VOC increase greater than 2 pounds per day
- SJV emissions factor 5.71 lbs of VOC per ton of greenwaste feedstock
- Offset purchase at 1.5:1 ratio for each ton of emissions over 10 tons per year

Outdoor ASP

85% VOC Capture / 500 tpd

- $35 million
- Biosolids and bulking agents
- Fully enclosed tipping and mixing areas
- Negative aeration to biofilter
- Synagro-Southern Kern County

Fully enclosed ASP

95% VOC capture

420 tpd

- $80 million
- Biosolids and bulking agents
- Converted IKEA warehouse vented to biofilter
- *Inland Empire Utilities District* - Rancho Cucamonga

Offset calculations

Emission factor	5.71	pounds of VOC per wet ton (windrow)		
NSR limit	20,000	pounds per year		
Incoming tons	500	tons per day		
	1,000,000	pounds per day		
	156,000	tons per year	6 days per week at max input	
Emissions	2,855	pounds VOC per day		
	890,760	pounds VOC per year		
ASP reduction @ 85%	757,146	pounds VOC removed		
ASP reduction @ 95%	846,222	pounds VOC removed		
Remaining emissions at 85% capture	133,614	pounds VOC emitted		
Remaining emissions at 95% capture	44,538	pounds VOC emitted		
Offset threshold	20,000			
NET at 85% capture	113,614	Cost at $18k/ton, 1.5:1 ratio	$ 1,533,789.00	OFFSETS
NET at 95% capture	24,538	Cost at $18k/ton, 1.5:1 ratio	$ 331,263.00	OFFSETS

Is this a factor in such a large investment?

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Any questions?

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http://www.calrecycle.ca.gov/Organics/Air/default.htm